Memorandum

Subject : A proposal to assemble the upper mechanisms with filter #7 and the optical payload implemented below the separating roof of the LAPP lower tower prototype.

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As defined in the FD, the upper mechanisms move the suspensions horizontally and vertically . These mechanisms are implemented in the upper tower vacuum compartment which is isolated from the lower compartment by the separating roof. The payload hangs on the suspension below that roof. As this roof rests on the lower tower, it cannot approach the mirror closer than 1 m.(to be confirmed)

The payload is an optical component hanging on a marionetta which controls its longitudinal position and vertical tilt. The marionetta is steered by a system of coils and magnets. Magnets are fixed to the marionetta, coils are fixed to legs fit to the last suspension stage, filter #7. The marionetta steering is effective with the magnet/coil configuration shown on fig.1. As a consequence, the separating roof has to be implemented with glass pots to allow the implementation of the requested configuration.

The assembly of such a system is a non trivial matter. The working party agreed thus to propose to the collaboration to test the assembly scenario and the operation of the system on the lower tower prototype installed at Annecy fig[2],[3]. It appears that the test can be done using essentially final components. It can be realized in due time without any destructive interference with VIRGO construction. It provides information on the tower assembly scenario which can be taken in account for the final on site assembly

A complete prototype payload will be available at Rome beginning of 1996. Upper mechanisms and filter #7 will be available at Pisa in the second semester of 1996. At that time, Lapp will provide a separating roof equipped with its pots, a technical ring and a mini internal structure to support the upper mechanisms. Preliminary studies have shown that a specific cupola will be needed to accomodate the limited height of the building available for the tests. As shown on fig [2], a stand is requested for the assembly of filter #7 with the upper mechanisms. With these components at hand we will test :

i)- The toolings necessary to fit filter #7 control legs into the glass pots.
This operation is difficult, due to the size of the assembled pieces.The filter can be guided with tools through the Ø250ports provided for the upper compartment pumping at z =1300.

ii)- The operation of a new, low conductance, separating roof.
- The roof is clamped after alignment. A pumping system is installed to minimize the conductance of the separating roof central hole.

ii)- The operation of the upper positioning mechanisms.
- These mechanisms center the suspension on the separating roof. It follows slowly the fast displacements of marionetta and reference mass.

iii)- Position control of the suspension with respect to the glass pots and the conductance hole.
- The position of the suspension wire with respect to the central hole of the separating roof is followed from outside by a camera looking through a window. Nothing exists yet to check the coil position with respect to the glass pots.

iv)- The assembly of a prototype payload.
A complete clean assembly of the prototype payload is mandatory .It is programmed since 1993. However, due to lack of manpower, the study of the payload assembly tools has not yet started.

v)- The connection of a real payload to a real suspension.
To achieve this operation, one needs to controll the loading of the suspension. Some dedicated tool has to be provided.
vi)- The realistic operation of marionetta and reference mass.
vii)- The mirror positioning and alignment with their final survey system.

1. The upper mechanisms

The first prototype of upper mechanism would be tested in the LAPP vacuum setup; it is expected to be available at Pisa in beginning 1996. After preliminary tests in air performed at Pisa it will be transferred to LAPP for full load (1.1 tons), in vacuum , tests. In these tests problems like cold welds under extrem loads and smooth functionality will be studied in depth.

2. Filter #7

Filter #7 is presently at the early engineering stage in Pisa. Its design parameters are not yet fully frozen. The latest coordination meeting has shown that it should be provided with a 4 degrees of freedom , remotely controlled motorization:
a) an upper suspension wire rotation mechanism will allow the correct orientation of the coil legs wit respect to the separating roof glass pots. This rotation was not foreseen and is made necessary by the more than expected torsion of the suspension wire when loaded and for possible subsequent torsional creeps.
b) a lower suspension wire rotation mechanism will allow the correct orientation of the marionetta arms to the filter #7 coils.
c) an x-y or an r ø movement will move a balancing mass that will insure perfect horizontality of the filter and its coils

The 4 legs of filter #7 will be equipped with the 6 marionetta steering coils. In order to realize the highest frequency mechanical resonances, the legs will be tubes as wide and as light as possible and the coils will also be as light as possible. Anodized aluminium wire is being considered to replace the standard enamelled copper wire.

Power dissipated in the coils needs to be evacuated toward the filter body , far from the optics chamber. Extensive 'in vacuum' power dissipation tests will be performed in the LAPP setup.

3. The optical payload and its transfer system.

A dummy mirror, a dummy reference mass and a real marionetta will be assembled at Rome to realize a dummy payload which will be mounted with its transfer system. The reference mass will be fit with the real size coils and the marionetta will be fit with its stepping motor balancing system.

Once ready at Rome, this system could be transferred to LAPP for the assembly test. In the mean time, Lapp will have to provide a final lower cover with a central Ø1000 access, the elevating jack and a fine positioning mechanism to fit the marionetta into the glass pots.

4. The separating roof.

A new design is mandatory. A conductance pumping system has to be implemented. Discussions with Pisa vacuum group are underway. A final decision on the necessity to move the roof under vacuum is not yet made.

5. The mini internal structure

A mini internal structure has to be provided to implement the upper mechanisms with filter #7 on the technical ring. Lapp provides it.

6. The technical ring and the small cupola.

A prototype technical ring realized for the Pisa suspension test is available from factory. Feedthroughs for the necessary controls have to be provided.

A standard cupola cannot be used. We propose to take a cupola from the final lower tower order:: the cupola of the signal recycling could be smaller than the others

7. Control command.

Upper mechanism, filter#7 and reference mass controls have to be available from Pisa. Their wiring has to be defined. Virgo online software could take advantage, if necessary, of this installation to make significant progress towards integration.

8. Survey of the mirror position.

The lower tower will be equipped with the windows required for the mirror survey. Rome and LAPP will provide cameras with their supports.

9. Contingencies and costs.

These test will take place in the second half of 1996. As a consequence the prototype tower has to stay fully equipped at LAPP untill the end of 1996.

The small cupola is the main expenditure specific to the proposed test. The mini internal structure is essentially a kind of fixture. The lower cover and the small cupola are parts of the final sery of lower tower components.